

Simulation of Aerially-Applied Deposits on Plants to Determine Efficacy

Juan D. Lopez Jr.
W. Clint Hoffmann
Ivan W. Kirk

USDA-ARS, Southern Plains Agricultural Research Center,
Areawide Pest Management Research Unit
College Station, TX

Research Entomologist

- Previous research on insect pests of cotton and corn without lots of emphasis on insecticides.
- New to aerial application technology research – switch late in my research career.
- First time presenter - Worried.
- Current research emphasis on efficacy enhancement of aerially-applied insecticides for control of insect pests on cotton and corn - without increased control costs.
- Work for you - Customers - **Appreciate feedback!**

Aerial Application of an Insecticide?

- Decisions
- Decisions
- Decisions
- Decisions
- More Decisions!
- Decisions to be made by producer/consultant, but primarily aerial applicator.

Effect of Decisions

- Influence on deposition
- Deposition = Efficacy = Bottomline
- “The precise delivery of pesticides and bioproducts to the intended targets is essential to achieve the desired biological effect and to minimize adverse impacts on the environment and adjacent land areas.” (Smith and Thomson 2003).

Effect of Decisions (con't)

- “It is essential to develop technology for either overcoming or managing these application problems in order to provide sustainable agricultural production.” (Smith and Thomson 2003)
- “The efficacy of crop-protection materials on targets is affected by a number of factors. The primary factor is the placement of the pesticide such that the pest receives a lethal dose.....**The primary concern of the applicator is to place the recommended amount of pesticide on the target.**” (Smith and Thomson 2003)

Effect of Decisions (con't)

- “However, uniformity of spray deposits, location specificity of deposit, plant surface properties, life stage of the pest and environmental conditions all affect the efficacy of the application.” (Smith and Thomson 2003)
- **These may just be just a few of the factors that affect efficacy, probably many more!**

Control Problems?

- Initially all control problems are blamed on the aerial applicator because coverage was not adequate.
- True because as control becomes marginal, coverage becomes more important.
- What is optimum coverage?
- Coverage = Deposition = Efficacy

Need

- A knowledge base readily available to agricultural producers/consultants and especially to applicators that relates aerial application equipment and parameters, material(s) being applied, environmental factors and etc. to deposition on plants and efficacy.

Aerial Applicator Deposition and Efficacy Guide (AADEG)

- Can this guide be developed through research using agricultural aircraft and actual crop production conditions?
- Considering everything that would be required, **No Way, Jose!**
- An alternative – Spray Table
- Verify significant findings in the field

Use of a spray table to relate deposits on plants to efficacy for cotton insect pests

- Appropriate because cotton insect pest control has and is undergoing major changes because of boll weevil eradication, Bt cotton, secondary insect pests that are becoming primary (stink bugs, tarnished plant bugs, cotton fleahoppers, etc.), new insecticides, etc.
- No silver bullets.
- Rough times!

Research Objectives

- To calibrate a spray table to reproducibly apply under controlled conditions deposits on plants with very specific and measurable characteristics.
- To conduct realistic bioassays to determine efficacy of the deposits.











SPRAY

LIGHT

EXHAUST

VEN









CTX CML-100
WALTON

Southern Plains Area
Southern Crops Research Laboratory
Agricultural Pest Mgmt Research Unit
2771 F&B Rd, Bldg. 2, Rm. 126
College Station, TX 77845

center
nozzle

(miles per hour)

Control Voltage

2.4

return

start run

Calibration of Spray Table for 2 and 5 gpa Treatments

	2 gpa	5 gpa
Nozzle No.	650033	8002E
psi	20	30
Nozzle/plant top''	45.0	25.5
Swath No.	2	3
Speed mph	8.5	4.5
Gpa	2.15	4.93
%<100 microns	0.632	3.614
VMD microns	183.92	240.28
No. drops/cm ²	8.74	78.17

Other Methods and Materials

- Cotton variety DeltaPine 436RR
- PixPlus @ 2 oz/acre to control growth
- Natural greenhouse infestation of cotton aphids and western flower thrips
- Cotton aphids sampled on individual leaves
- Thrips sampled by whole plant washing with alcohol
- Pretreatment and 3, 5, 7 and 14 DAT samples.
- Silwet 77 added to all insecticidal sprays (0.05%v:v)

Insecticide	Recommended Use Rates (oz/acre)	
	Cotton Aphids	Thrips
Acetamiprid (Intruder) 70WP	0.6-1.1	
Thiametoxam (Centric) 40WP	2	
Dicrotophos (Bidrin 8)	4-8	0.8-1.6
Spinosad (Tracer)		2.14-2.9

Deposit characteristics (2-gal/A) of insecticide sprays in a spray table

	Volume<100µm %	D _{v0.5} µm	Relative span	Drop Density, No./cm ²
Bidrin	3.01ab	243b	0.83a	65a
Centric	1.75b	310a	0.83a	64a
Intruder	5.57a	242b	0.81a	35a
Orthene	2.20b	276ab	0.82a	34a

Means followed by the same lower case letter are not significantly different (P = 0.05).

Deposit characteristics (5-gal/A) of insecticide sprays in a spray table

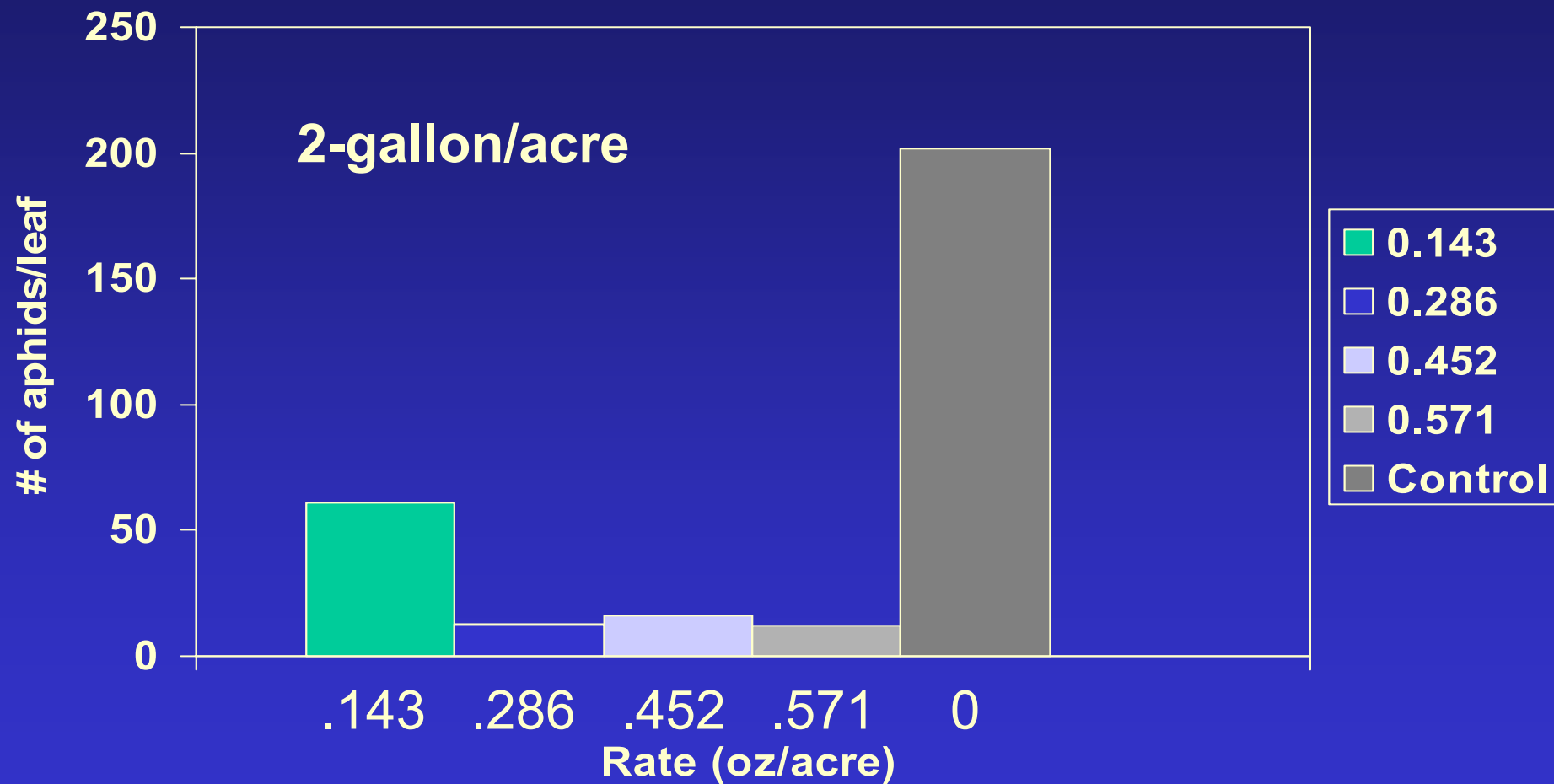
	Volume<100μm %	D _{v0.5} μm	Relative span	Drop Density, No/cm ²
Bidrin	8.11a	234b	0.81a	56a
Centric	8.42a	200b	0.82a	62a
Intruder	1.67b	326a	0.86a	49a
Orthene	2.05b	339a	0.81a	53a

Means followed by the same lower case letter are not significantly different (P = 0.05).

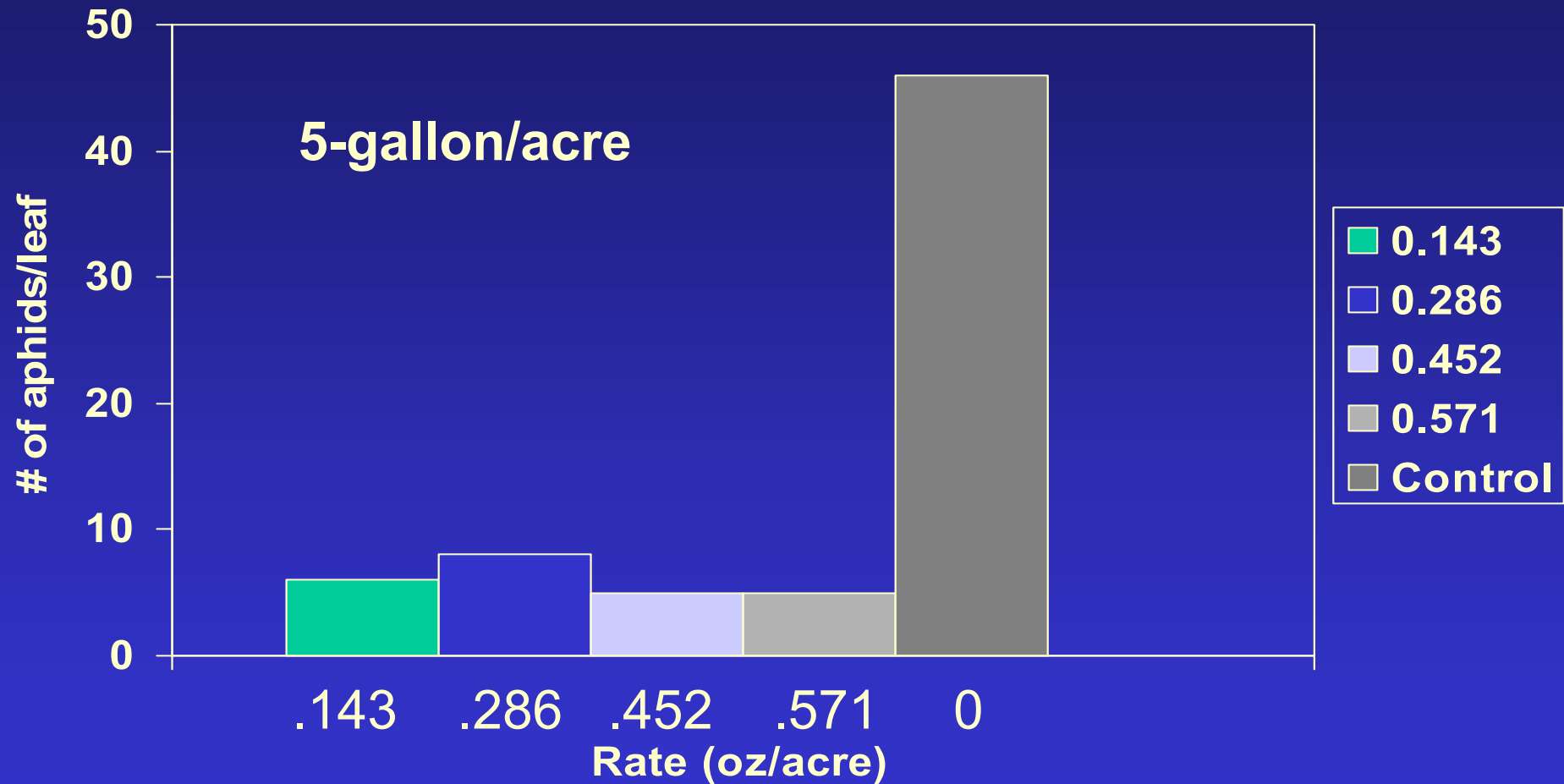


Results of tests with cotton aphids

Efficacy of Intruder on Green House Aphids 3-days after treatment

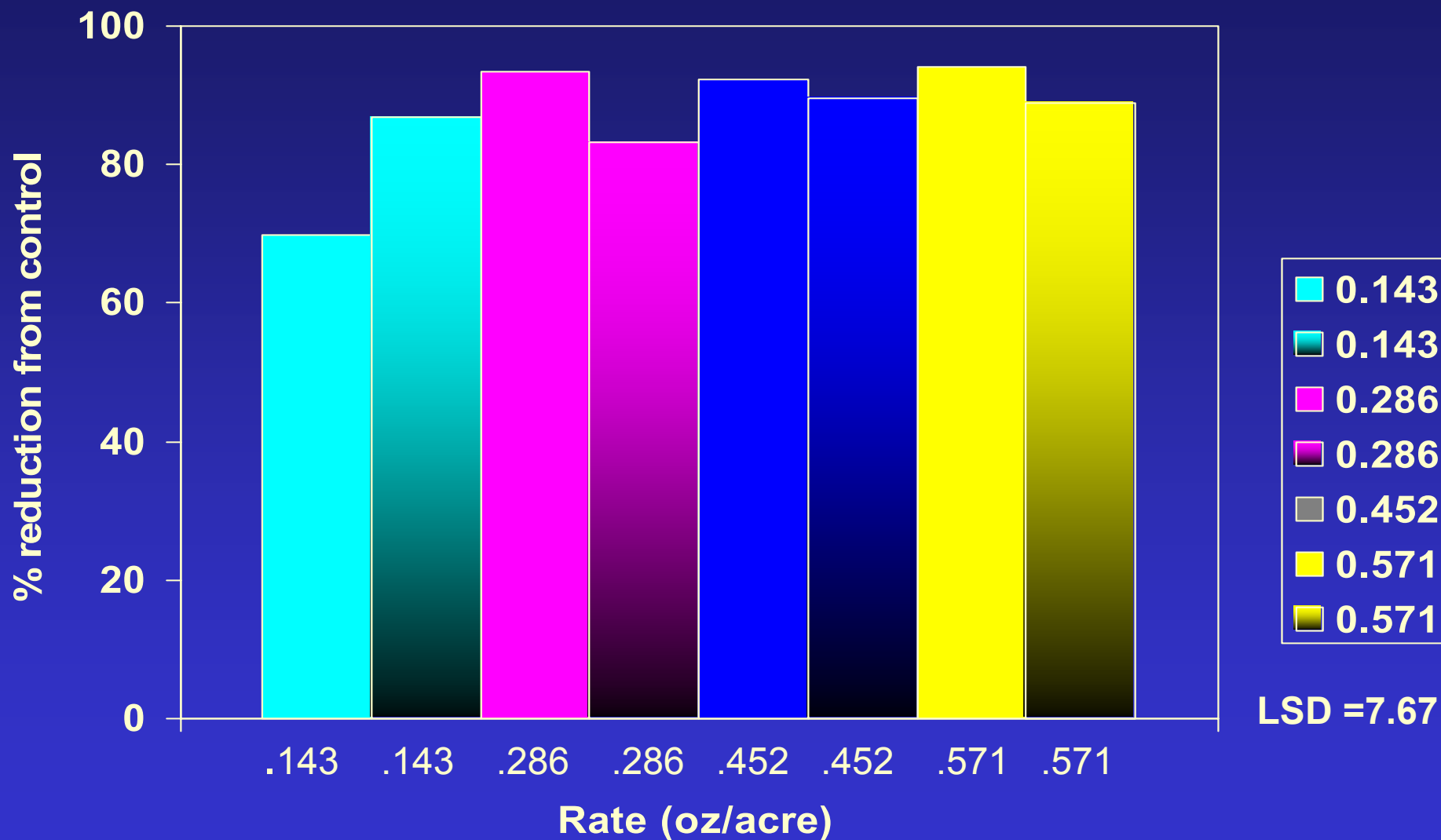


Efficacy of Intruder on Green House Aphids 3-days after treatment

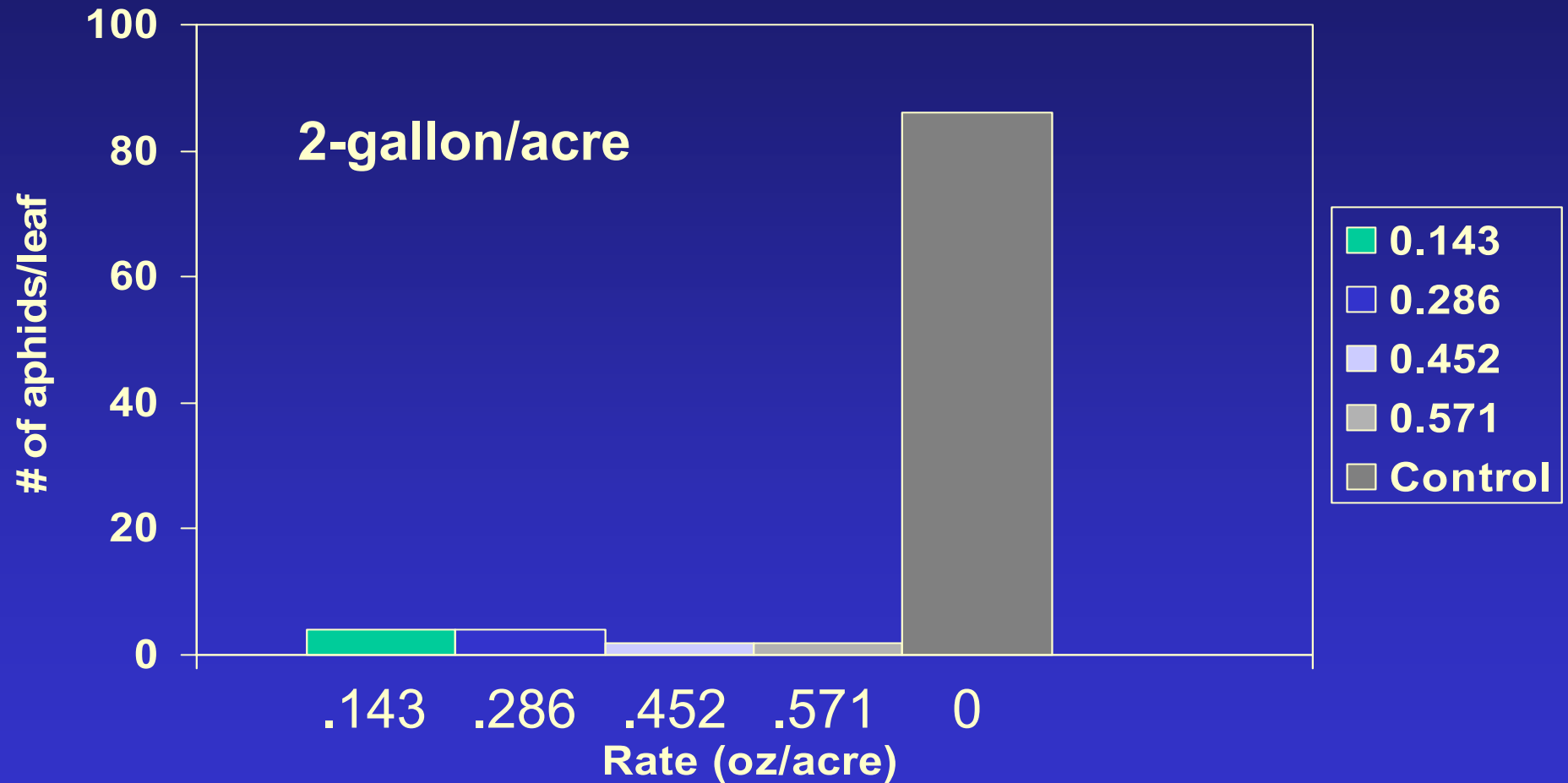


Efficacy of Intruder on Aphids

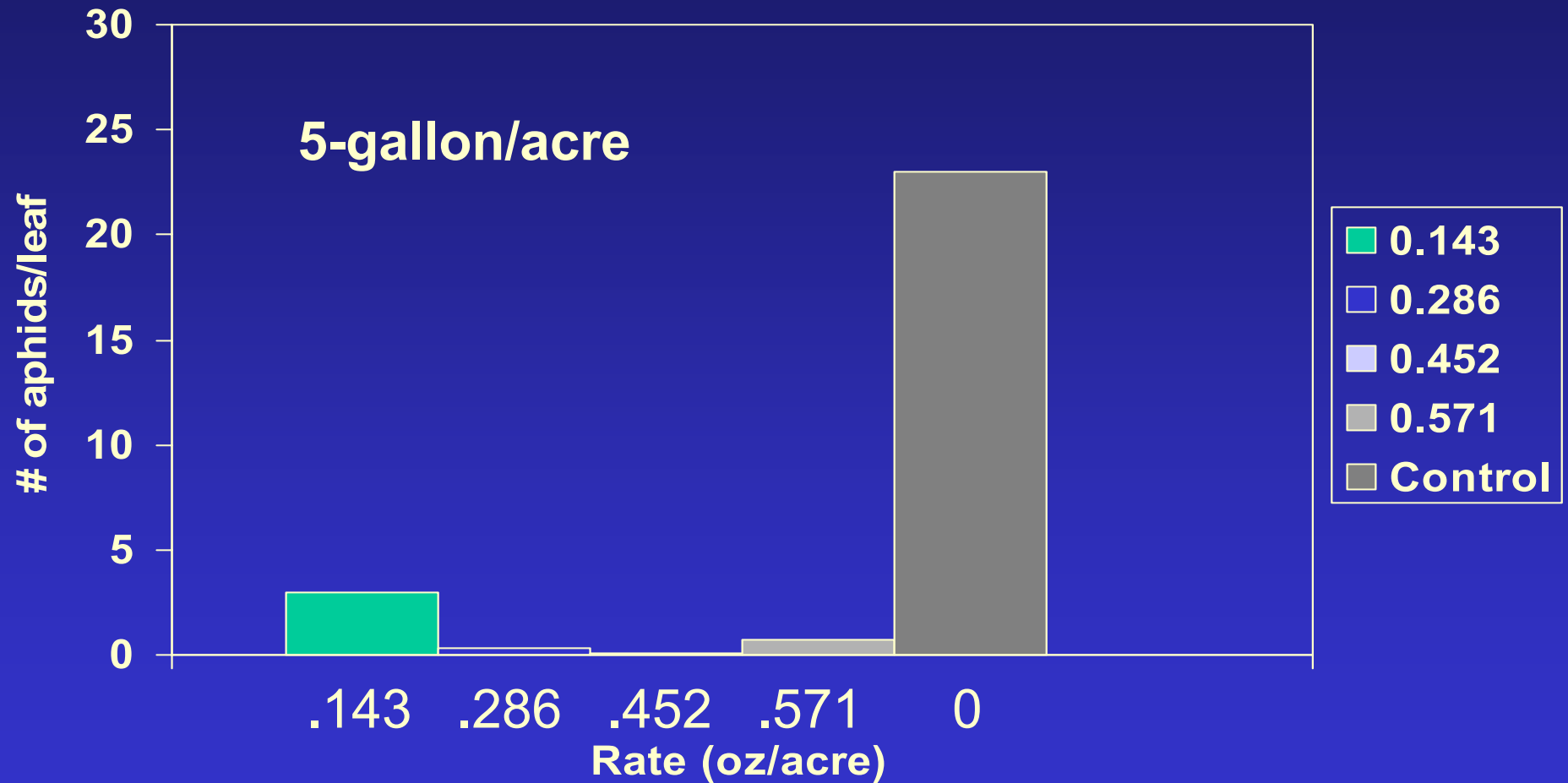
3-days after treatment



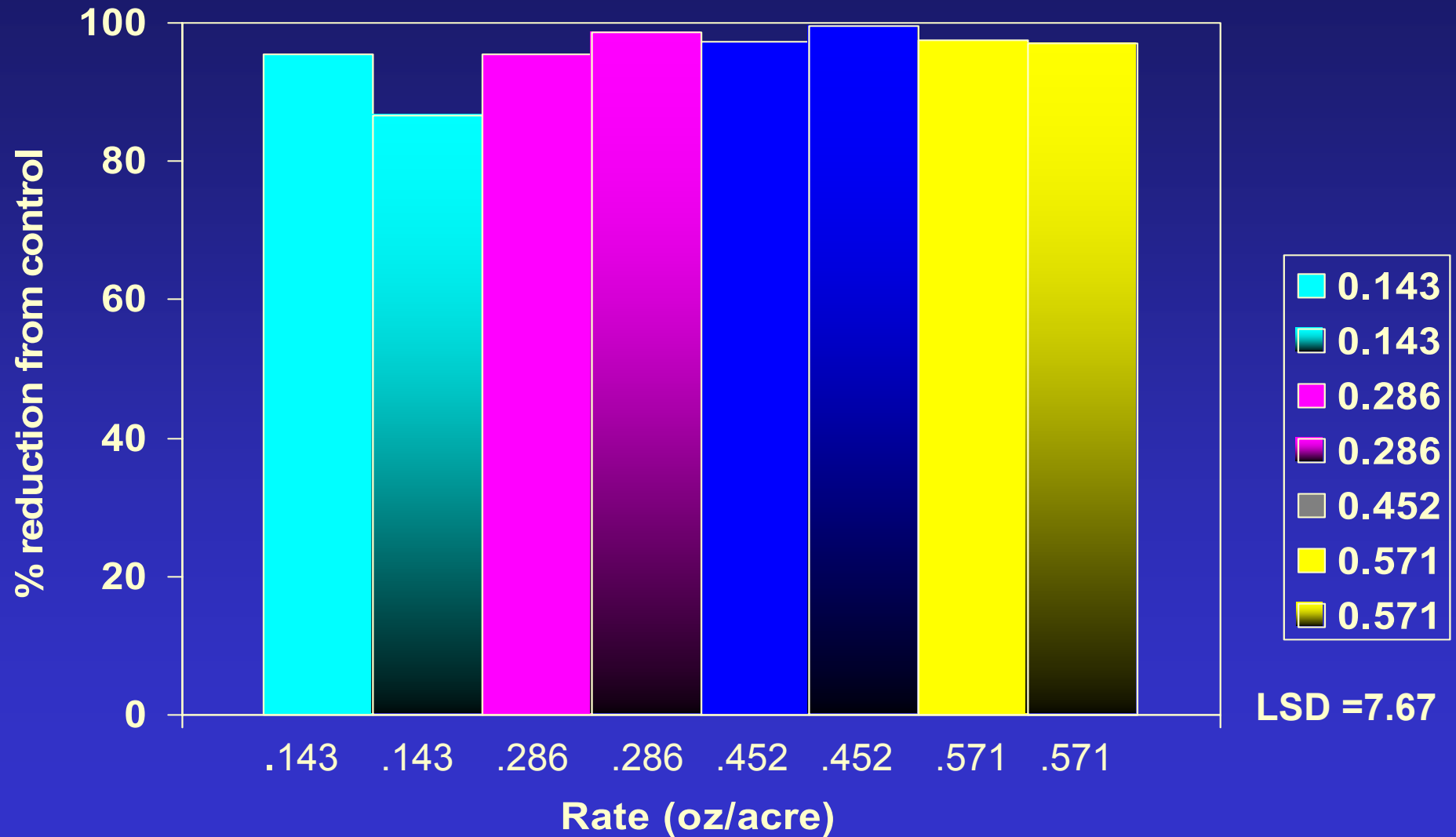
Efficacy of Intruder on Green House Aphids 14-days after treatment



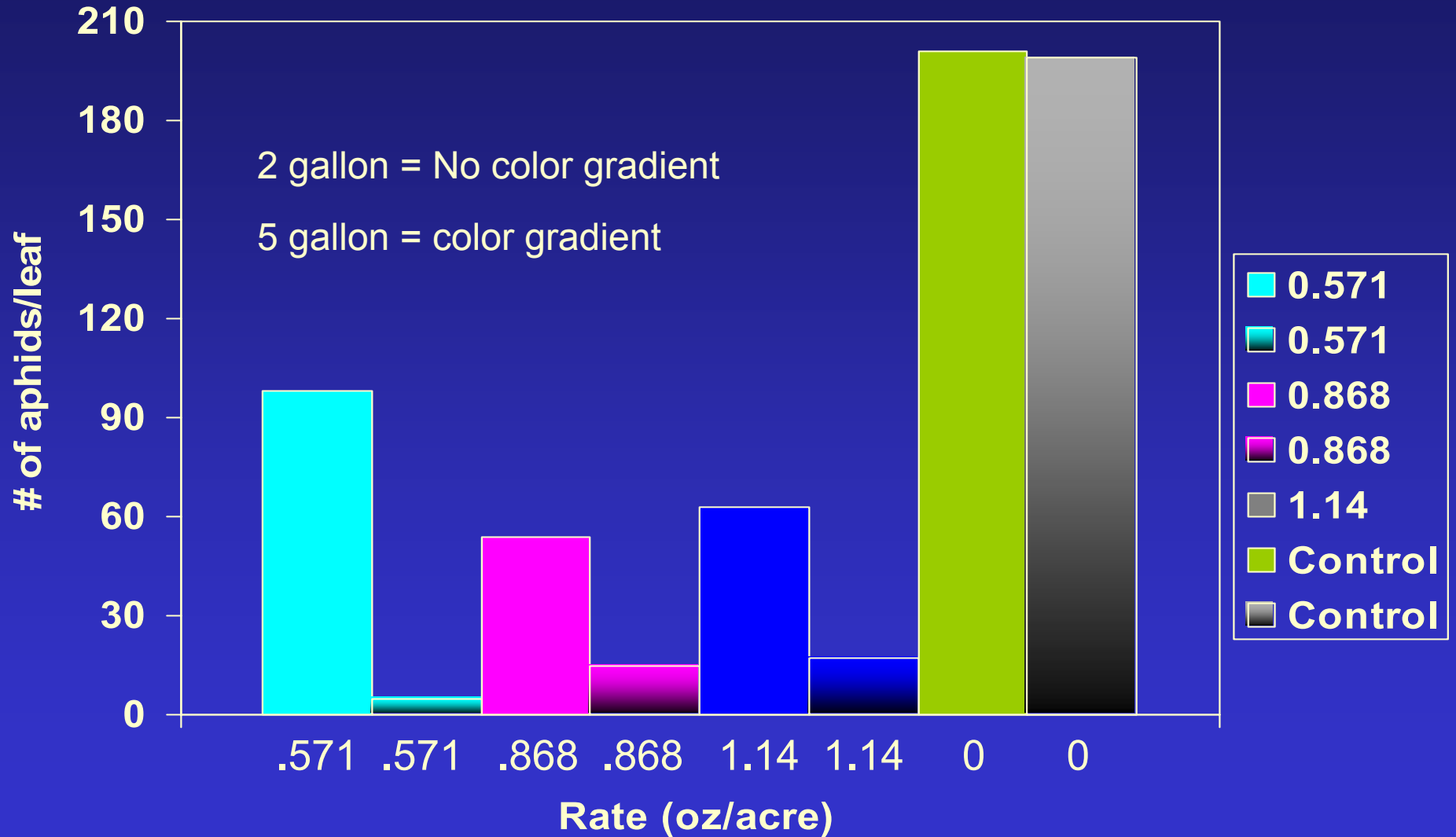
Efficacy of Intruder on Green House Aphids 14-days after treatment



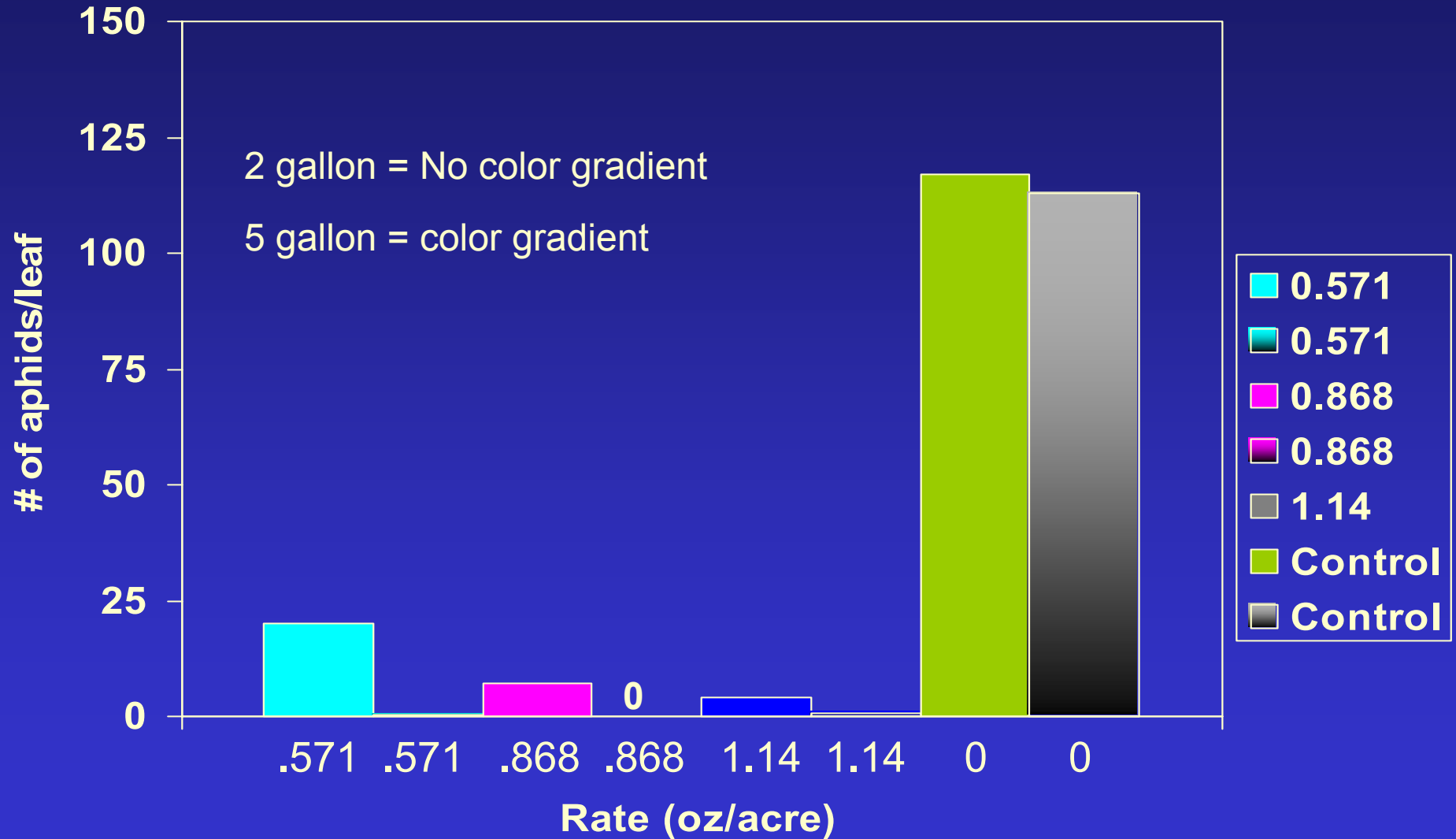
Efficacy of Intruder on Aphids 14-days after treatment (2 & 5 GPA)



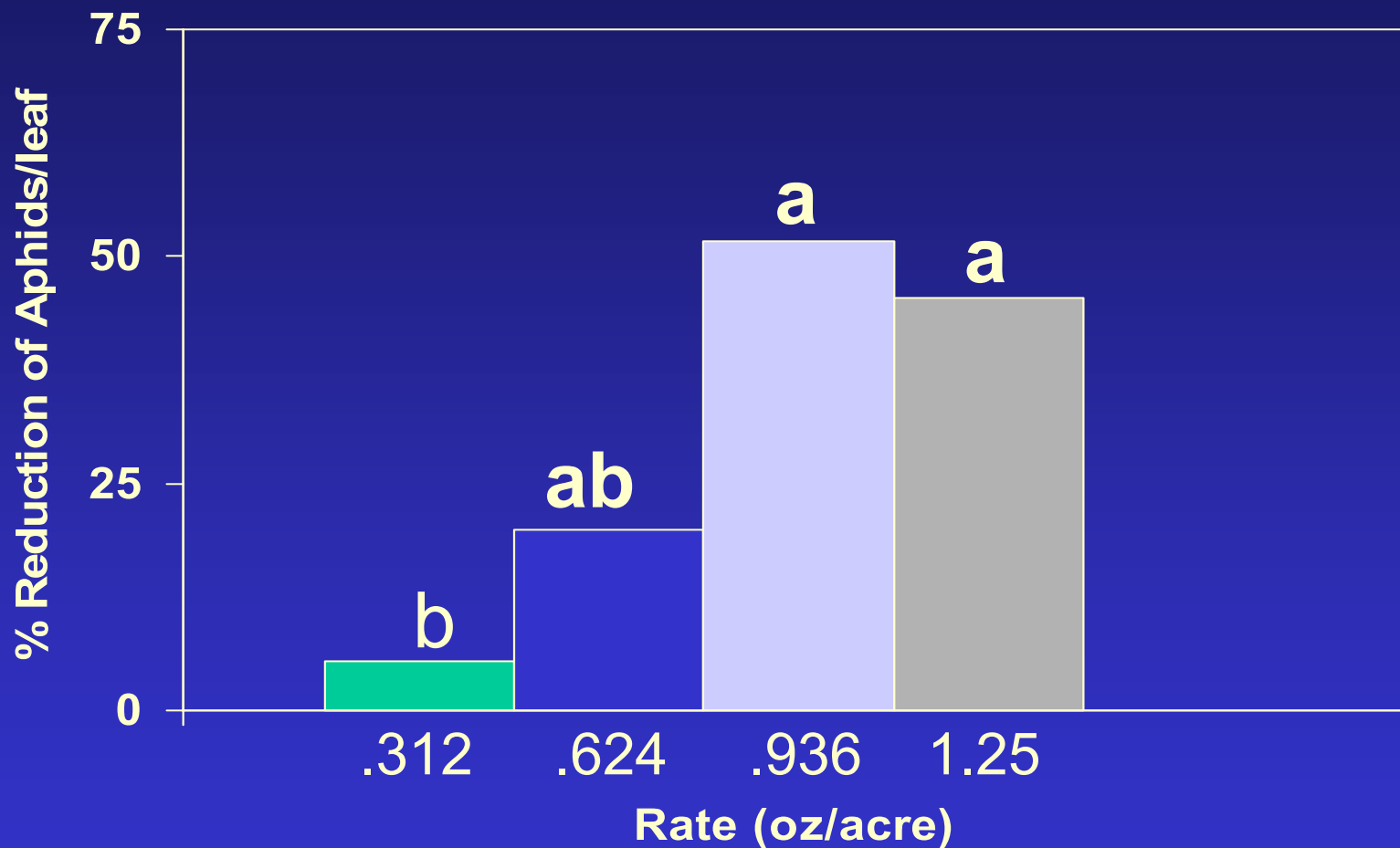
Efficacy of Intruder on Aphids 3-days after treatment



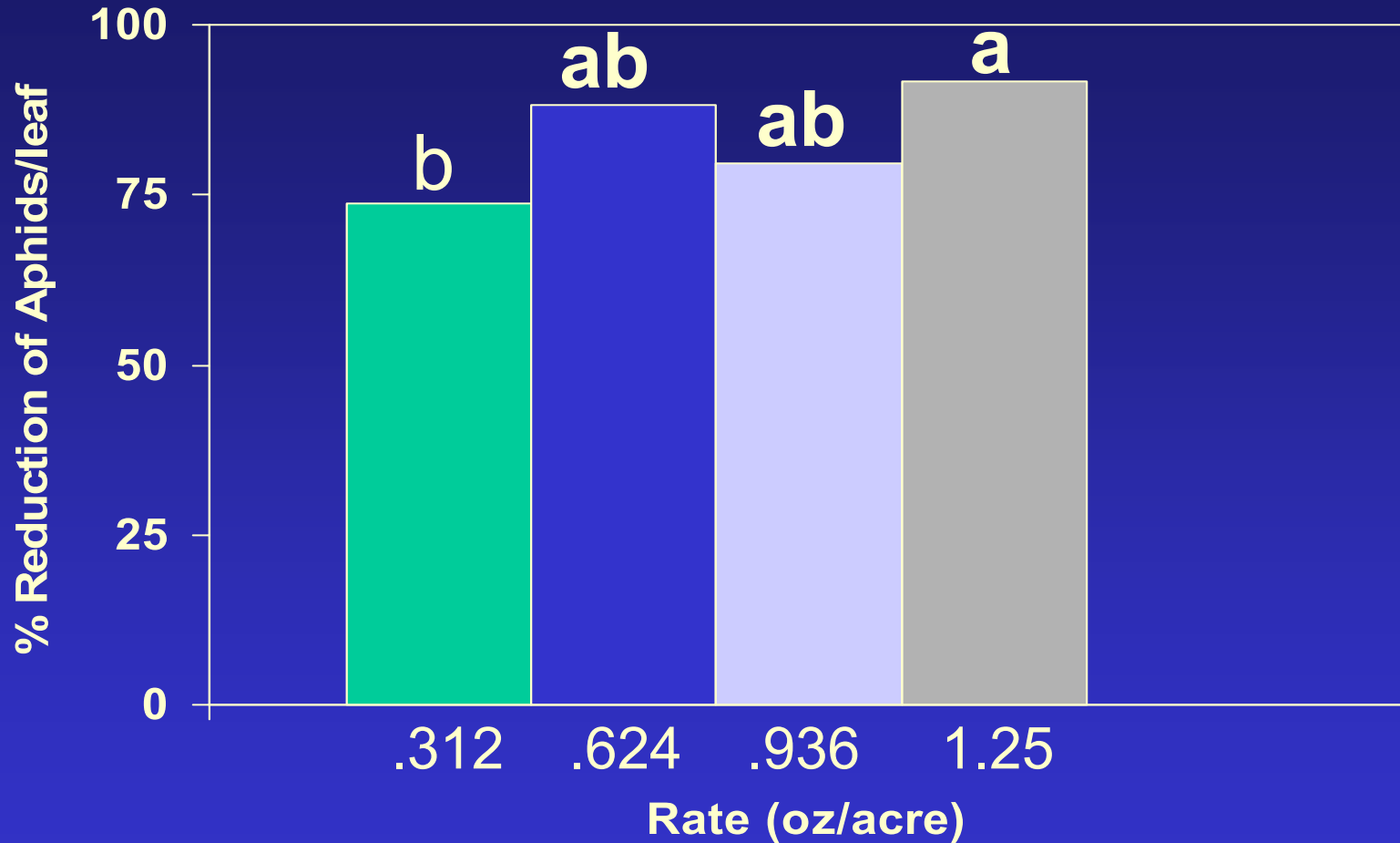
Efficacy of Intruder on Aphids 14-days after treatment



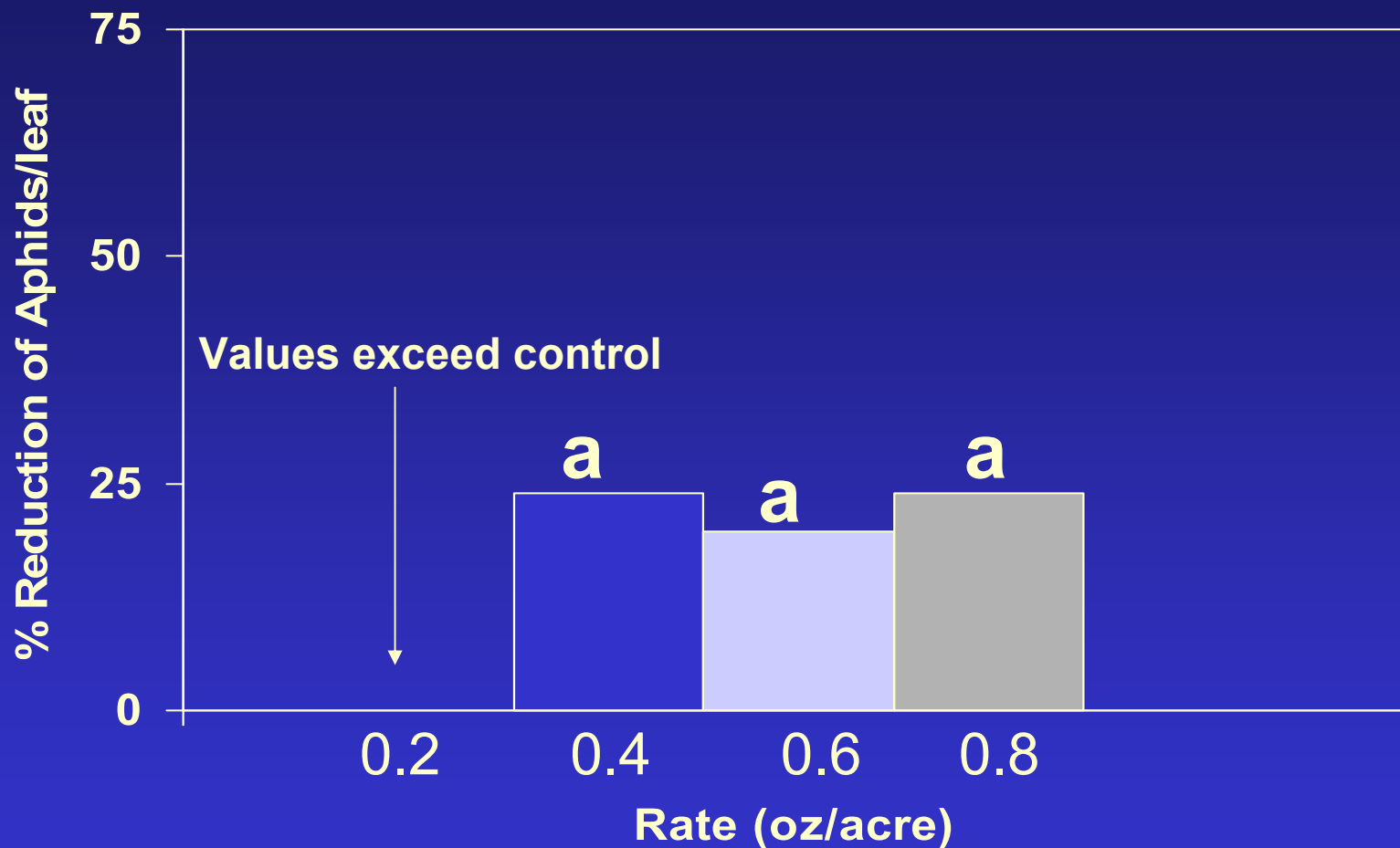
CENTRIC 40 WG vs APHIDS (2-gallon/acre) 3-days after treatment



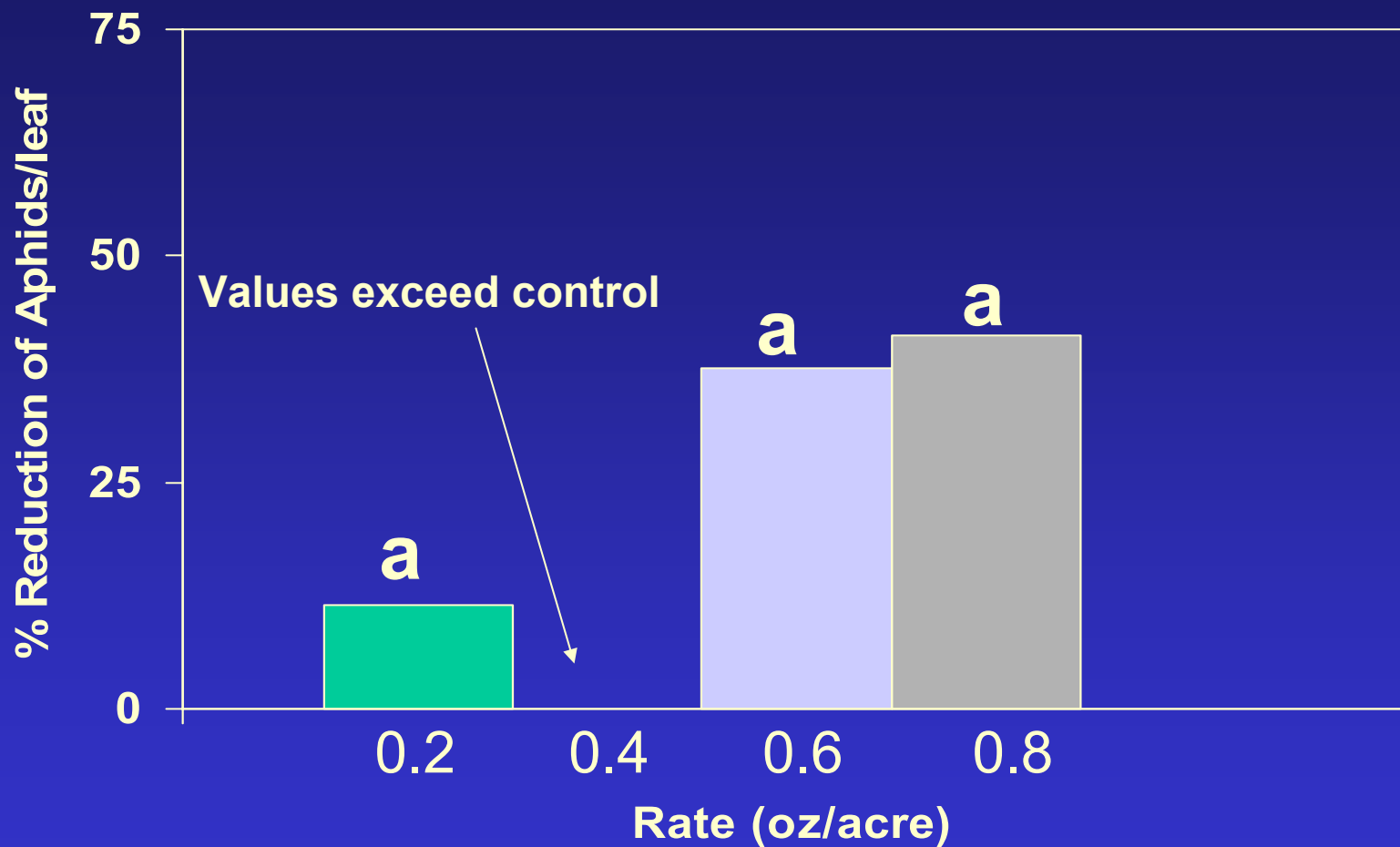
**CENTRIC 40 WG vs APHIDS (5-gallon/acre)
14-days after treatment**



BIDRIN vs APHIDS (2-gallon/acre) 7-days after treatment

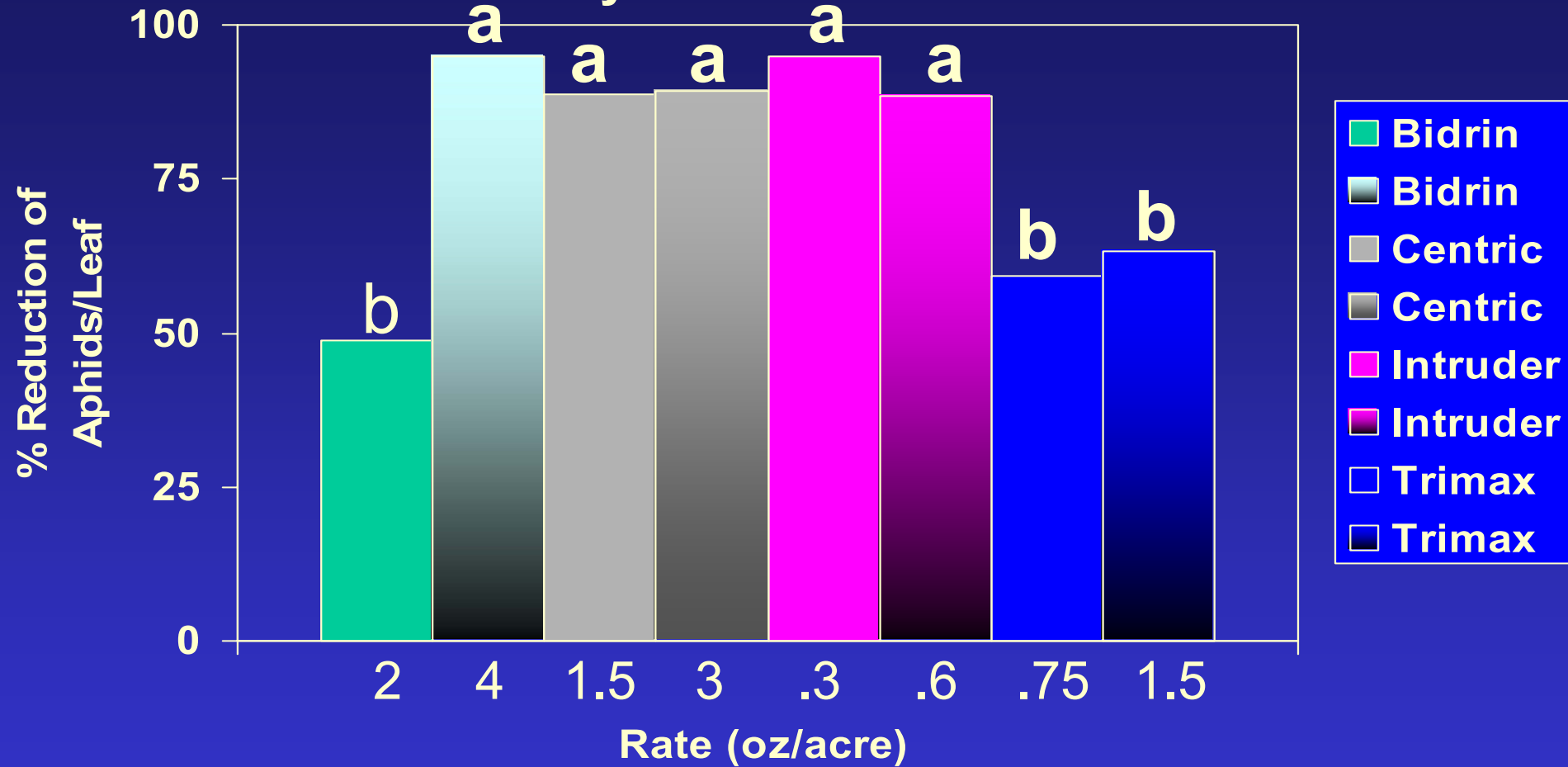


BIDRIN vs APHIDS (5-gallon/acre) 7-days after treatment



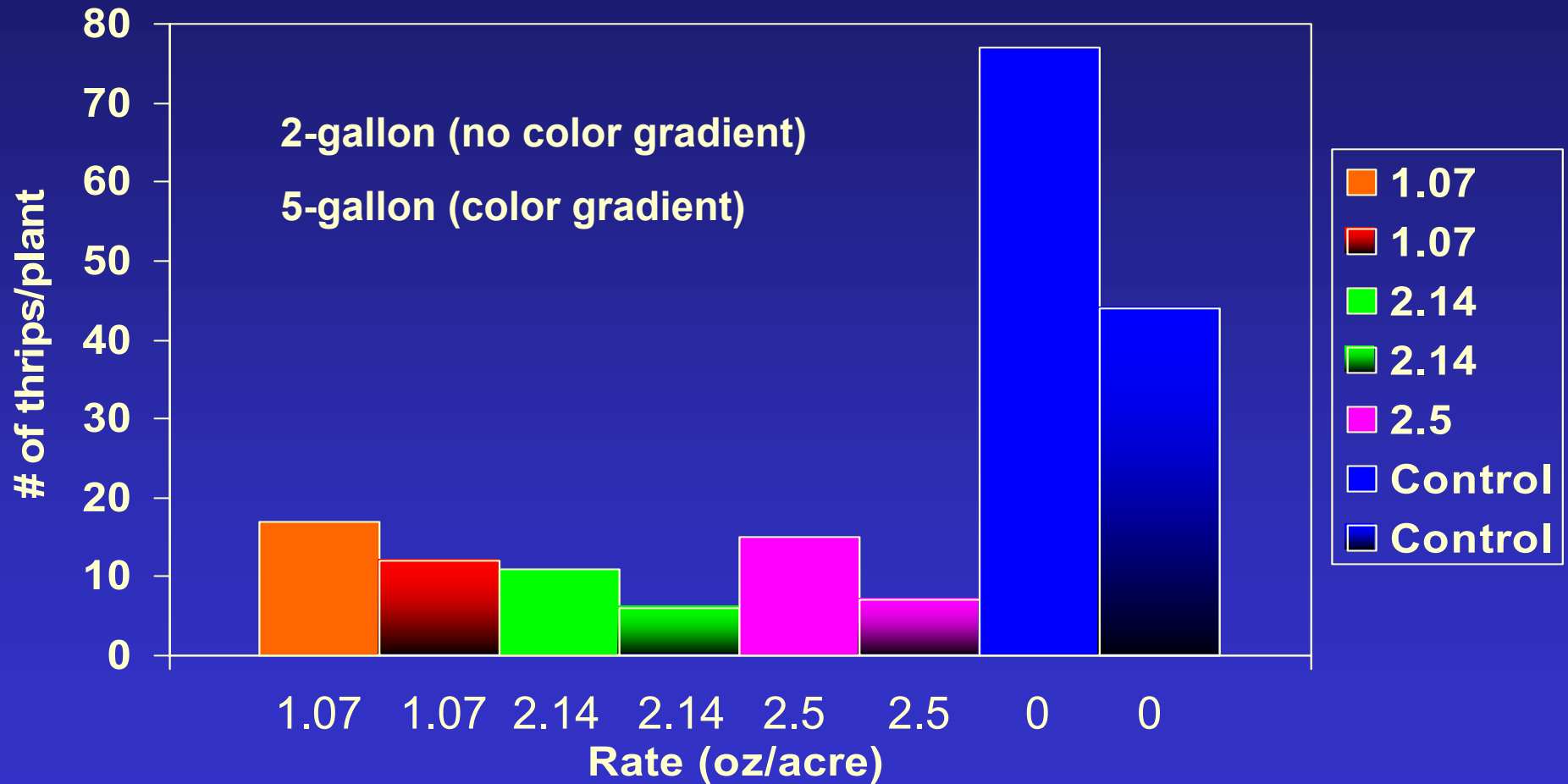
Bidrin, Centric Intruder & Trimax vs APHIDS (2gallon/acre)

3-days after treatment

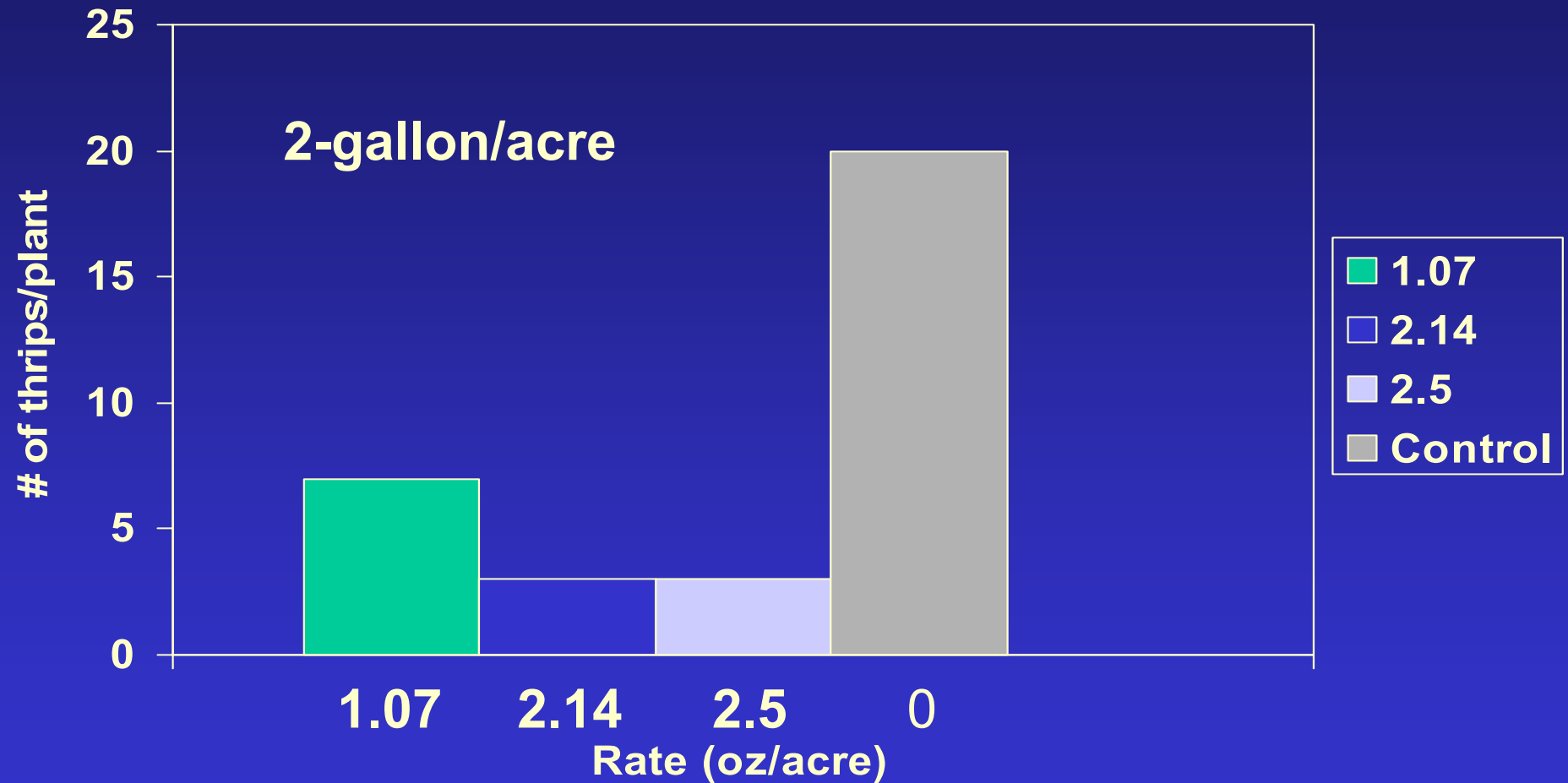


Results of tests with thrips

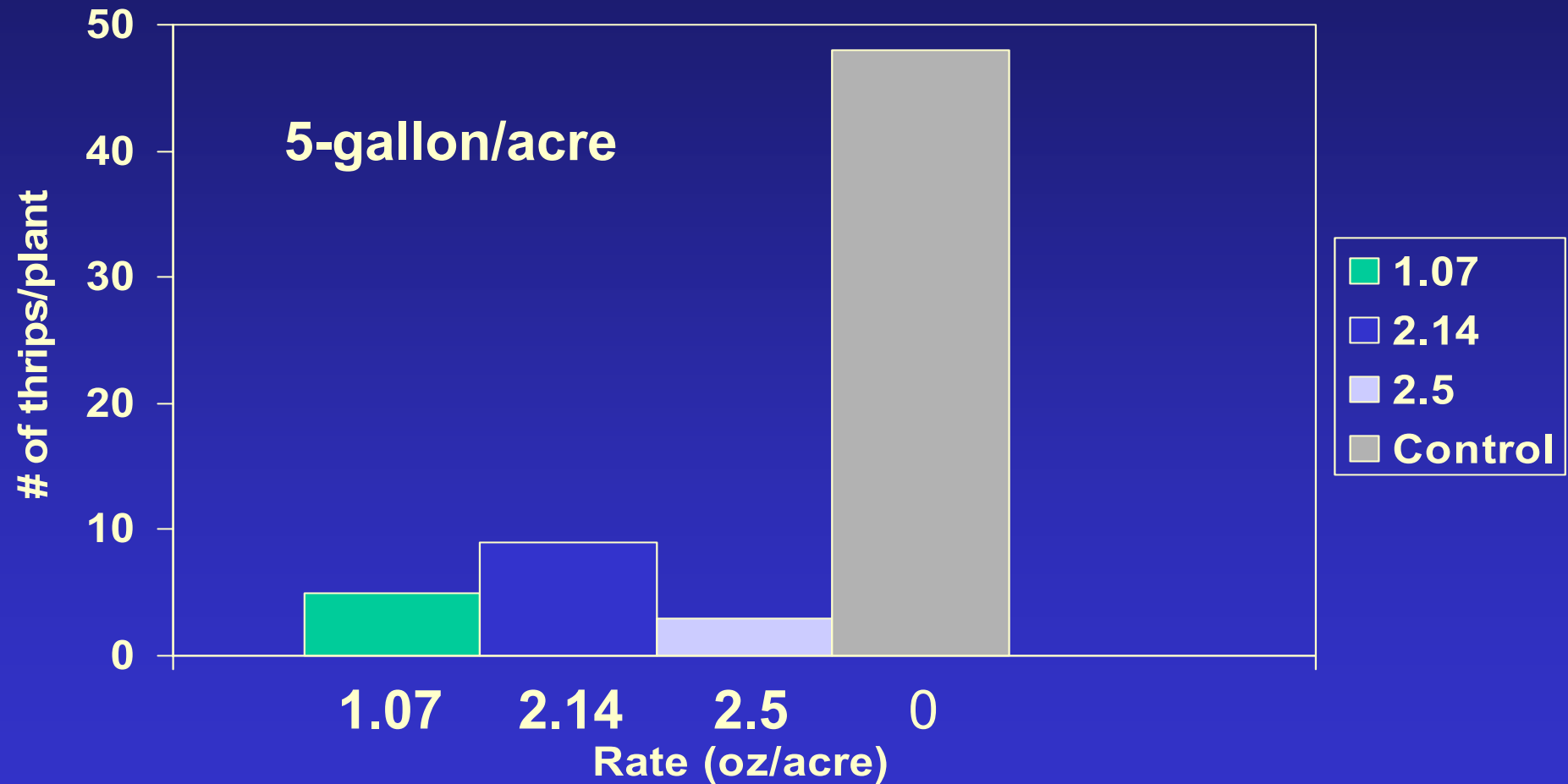
Efficacy of Tracer on Thrips in a Greenhouse 3-days after treatment



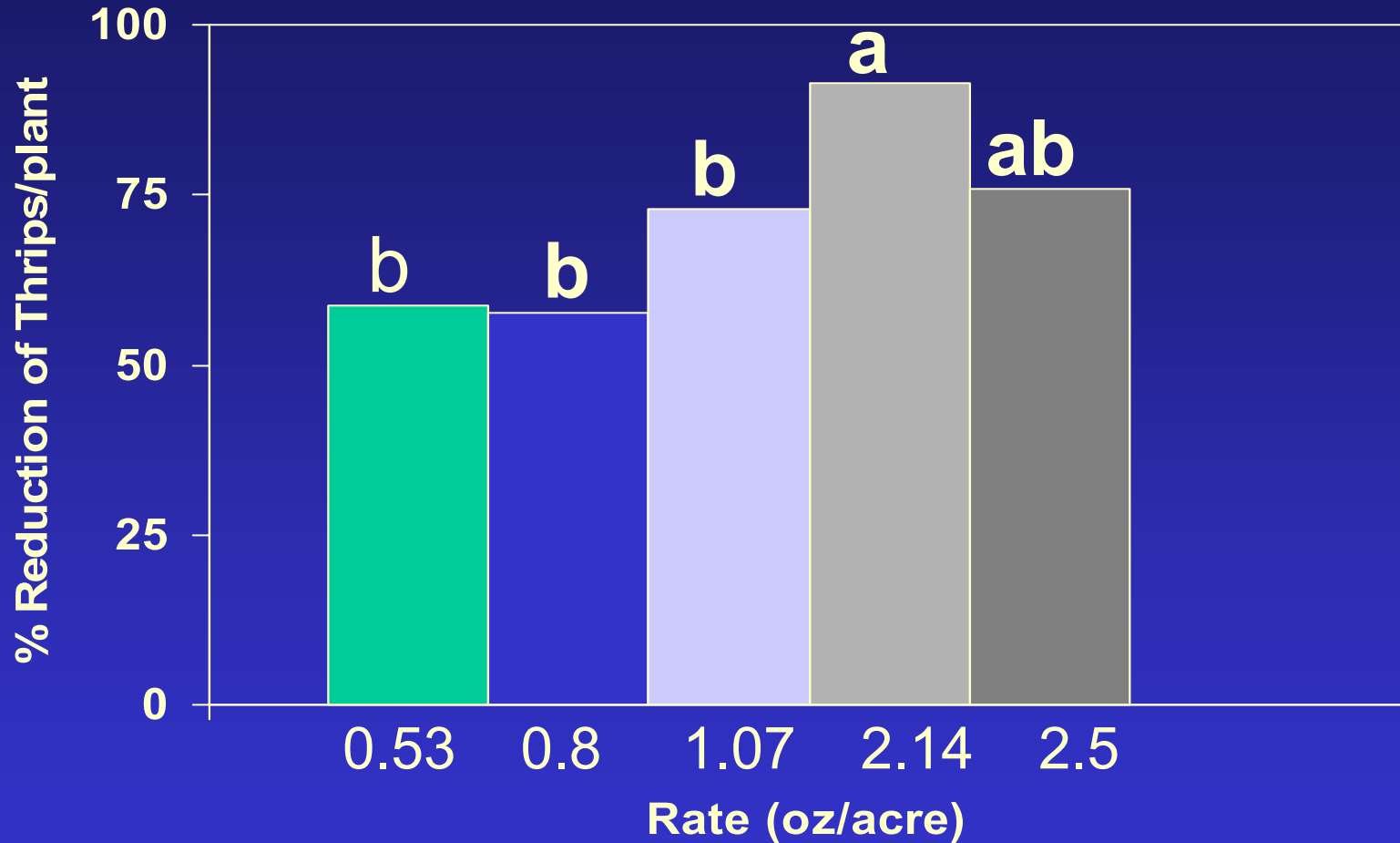
Efficacy of Tracer on Thrips in a Greenhouse 14-days after treatment



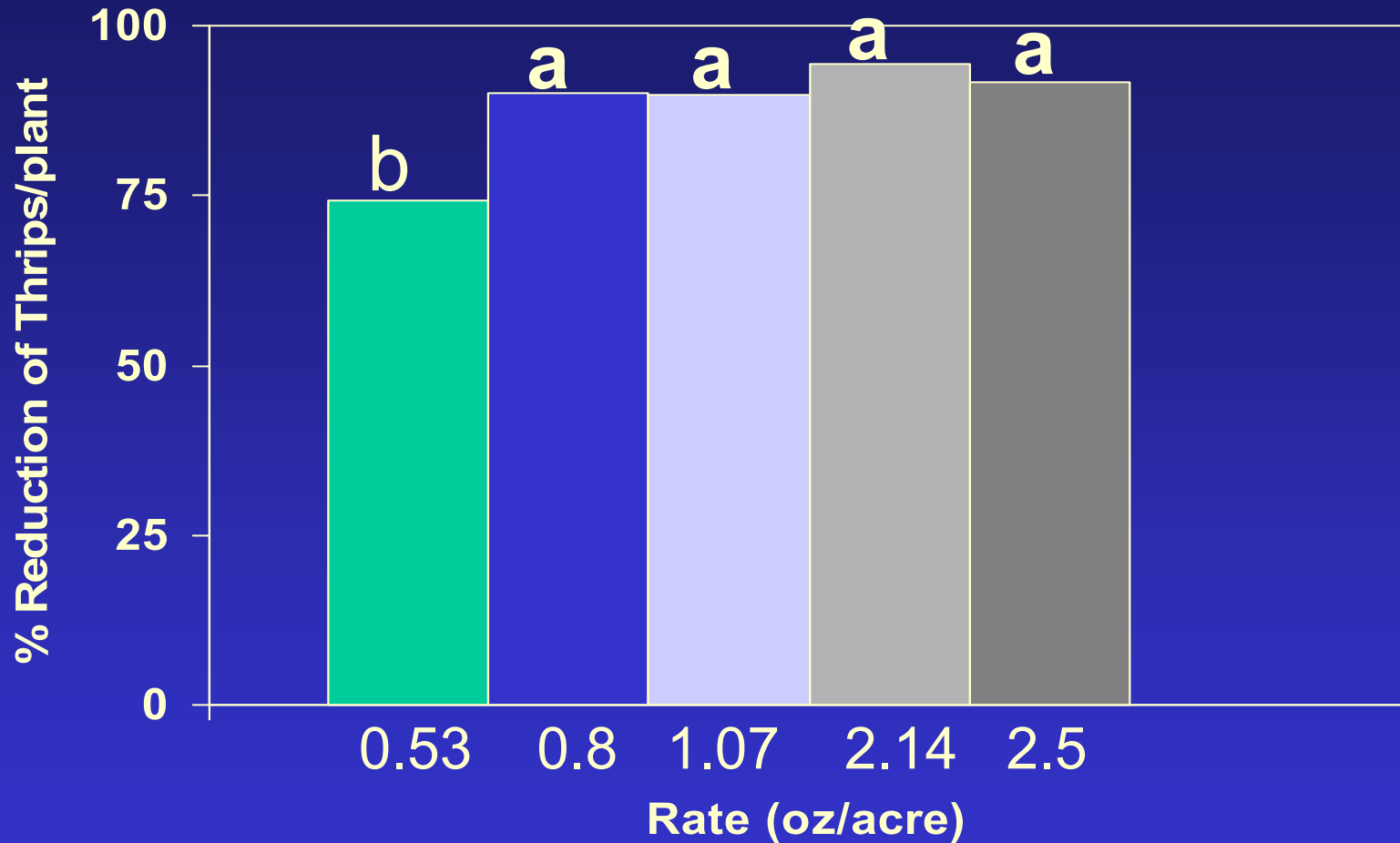
Efficacy of Tracer on Thrips in a Greenhouse 14-days after treatment



TRACER vs THRIPS (2-gallon/acre) 7-days after treatment



TRACER vs THRIPS (5-gallon/acre) 7-days after treatment



Conclusions

- Use of spray table evaluations for deposition-related efficacy is doable.
- Considerable work is needed to calibrate the spray table to apply deposits for evaluation.
- Realistic bioassays to determine efficacy of deposits are important.
- This is just a start!